

REMARKS

Claims 1-21, 23, 25 and 27-77 remain pending in the application, with claims 27-77 being withdrawn from consideration by the Examiner.

Allowable Claims

The Applicant thanks the Examiner for the indication that claim 8 is allowed, with the previous notice that claims 15 and 17 were allowable having now been withdrawn.

35 USC 112 Second Paragraph Rejection of Claims 9-14, 15, 21, 23 and 25

The Office Action rejected claims 9-14, 15, 21, 23 and 25 as allegedly being indefinite under 35 USC 112, second paragraph. In particular, the Examiner rejects the claim language “plurality of positions including multiple reflections, multiple sources without reflections, and multiple sources with multiple reflections”. The Examiner alleges the subject language is unclear in “whether or not the sound signal composed of the plurality of sound source positions is composed of three components based upon reflections or composed of two components based upon reflections”. (see Office Action, page 2).

Claims 9-14, 15, 21, 23 and 25 recite a list of positions that clearly includes three components, i.e., multiple reflections, multiple sources without reflections, and multiple sources with multiple reflections. Two of the components clearly recite being based upon reflections, one broadly as “multiple reflections”, and one more narrowly as “multiple sources with multiple reflections”. The third component is clearly recited as being based on “multiple sources without reflections”.

Therefore, claims 9-14, 15, 21, 23 and 25 recite two components based on reflections and a third based on multiple sources without reflections. It is respectfully submitted that the claims are in full conformance with 35 USC 112. It is respectfully requested that the rejection be withdrawn.

Claims 1-7 and 16-19 over Chen

In the Office Action, claims 1-7 and 16-19 were rejected under 35 USC 103(a) as allegedly being obvious over Chen, U.S. Pat. No. 5,500,900 to Chen (“Chen”). The Applicant respectfully traverses the rejection.

Claims 1-7 recite a characteristic function representing a head-related impulse response includes a spatial characteristic function determined for a selected number of samples and a selected number of eigen values. Claims 16-19 recite a source placement array for filtering a sound signal in accordance with a head-related impulse response and a plurality of eigen filters attached to a source placement array and receiving a signal therefrom, the eigen filters introduce time delays into the signal.

Chen discloses a free-field-to-eardrum transfer function (FETF, an previous name for an HRTF) developed by comparing auditory data for points in three-dimensional space for a model ear and auditory data collected for the same listening location with a microphone (Abstract). Each FETF is represented as a weighted sum of frequency-dependent functions obtained from an expansion of a measured FEFT covariance matrix (Chen, Abstract). Spatial transformation characteristic functions (STCF) are applied to transform the weighted frequency-dependent factors to functions of spatial variables for azimuth and elevation (Chen, Abstract). A generalized spline model is fit to each STCF to filter out noise and permit interpolation of the STCF between measured points (Chen, Abstract). A spline model used to generate the STCFs, smooths measurement noise and enables interpolation of the STCFs between measurement directions (Chen, col. 5, lines 18-20). A regularizing parameter within the spline model controls a trade-off between smoothness of a solution and its fidelity to the data (Chen, col. 5, lines 29-31).

Chen fails to disclose, as acknowledged by the Examiner, use of a head related impulse response (Office Action, page 7). However, the Examiner alleges that the basis of the rejection is that a head related impulse response is no different than a head related transfer function, and the Applicant has not provided a statement indicating the difference between the two (Office Action, page 7).

One of ordinary skill in the art would recognize that a head related impulse response is different than a head related transfer function, with each being terms of art. Furthermore, to emphasize that the Applicant is using the terms as to their accepted definitions within the art, the Examiner is directed to the Applicant's specification, e.g., page 9, lines 13-14. The Applicant's invention discloses obtaining head related impulse responses by taking the inverse discrete Fourier Transform of the head related transfer functions. Thus, head related impulse responses are derived from, not the same as as alleged by the Examiner, head related transfer functions.

Chen fails to disclose use of a head related impulse response, as acknowledged by the Examiner, and as recited by claims 1-7 and 16-19.

Accordingly, for at least all the above reasons, claims 1-7 and 16-19 are patentable over the prior art of record. It is therefore respectfully requested that the rejections be withdrawn.

Claims 21, 23 and 25 over Begault

In the Office Action, claims 21, 23 and 25 were rejected under 35 USC 103(a) as allegedly being obvious over Begault, U.S. Patent No. 5,438,623 ("Begault"). The Applicant respectfully traverses the rejection.

Claim 21 recites, *inter alia*, a plurality of filters that remain constant, with at least one of at least one delay element, at least one attenuator, and plurality of weighting elements adapted to change a perceptive position of a sound source signal to a listener, with a plurality of sound signals comprise multiple reflections, multiple sources without reflections, and multiple sources with multiple reflections. Claims 23 and 25 recite, *inter alia*, a filtered attenuated sound signal that remains constant, with at least one of a delayed sound source signal, an attenuated sound source signal, and weighted filtered sound signals that are adapted to change a perceptive position of a sound source signal to a listener, with a plurality of sound signals comprising multiple reflections, multiple sources without reflections, and multiple sources with multiple reflections.

Begault discloses a head-related transfer function that can be recorded using an impulse response. (Begault, col. 1, lines 54-57). Begault

discusses the digital implementation of the binaural impulse response by convolving the input signal in the time domain with the impulse response of two HRTFs using two finite impulse response filters. (Begault, col. 1, lines 59-63).

The Office Action correctly acknowledged that Begault fails to disclose sound reflections as claimed (Office Action, page 6). However, the Office Action alleges that because Begault discloses input audio signals that are discrete from each other and that sound sources with reflections are well known within the art, it would have been obvious to modify Begault to process reflections for enhancing the spatial effect of the input signal. The Applicant respectfully disagrees.

As Applicant disclosed within the specification, for example, to render a 3-D sound image in a room with reasonable spatial impression, reflections of walls must be taken into account. Each reflected sound is also subject to head related transfer function filtering, as reflections usually come from different directions. If only first order reflections are considered, there will be six additional sources to be simulated. This will increase the computing load by a factor of seven. If secondary reflections are considered, then thirty-seven sources need to be simulated. This method quickly exhausts the computing power of any commercially available, single-chip DSP processor.

Thus, processing of reflections is a complicated and processor intensive operation. Begault's system is NOT sophisticated enough to handle processing the number of sound signals involved with processing discrete audio signals and their sound reflections. Processing discrete audio signals does not address the problems associated with processing reflections, a specific type of audio signal. Simply processing audio signals that are discrete from each other does not disclose or suggest processing reflections, much less processing of multiple reflections, multiple sources without reflections, and multiple sources with multiple reflections, as recited by claims 21, 23 and 25.

Accordingly, for at least all the above reasons, claims 21, 23 and 25 are patentable over the prior art of record. It is therefore respectfully requested that the rejections be withdrawn.

Claim 20 over Chen in view of Sekine

Claim 20 was rejected under 35 USC 103(a) as allegedly being obvious over Chen in view of Sekine et al., U.S. Patent No. 5,822,438 ("Sekine"). The Applicant respectfully disagrees.

Claim 20 is dependent on claim 16, and is allowable for at least the same reasons as claim 16.

Claim 20 recites, *inter alia*, a signal input for receiving a signal representing sound originating at a plurality of positions in space, and a left channel and a right channel comprising a source placement array for filtering the sound signal in accordance with a spatial characteristic function, wherein the spatial characteristic function is a head-related impulse response, a plurality of eigen filters attached to a source placement array and receiving the signal therefrom, wherein the eigen filters introduce time delays into the signal.

As discussed above, Chen fails to disclose or suggest a signal input for receiving a signal representing sound originating at a plurality of positions in space, and a left channel and a right channel comprising a source placement array for filtering the sound signal in accordance with a spatial characteristic function, wherein the spatial characteristic function is a head-related impulse response, a plurality of eigen filters attached to a source placement array and receiving the signal therefrom, wherein the eigen filters introduce time delays into the signal, as recited by claim 20.

The Office Action relies on Sekine to allegedly make up for the deficiencies in Chen to arrive at the claimed invention. The Applicant respectfully disagrees.

Sekine appears to disclose an electronic musical instrument that provides a sound image position control (Abstract). The apparatus provides a signal mixing portion and a virtual-speaker position control portion (Sekine, Abstract). Various delayed signals are multiplied by a predetermined coefficient to create virtual speaker sounds (Sekine, col. 5, line 66-col. 6, line 27). A head transfer function is created from an observation of experimental values obtained from a transfer function of a dummy head (Sekine, col. 5, lines 21-57).

Sekine fails to even mention use of eigen filters or a head-related impulse response. And as discussed above, a head-related impulse response is **NOT** a head related transfer function. Sekine fails to disclose or suggest use of eigen filters in combination with a head-related impulse response for a signal input for receiving a signal representing sound originating at a plurality of positions in space, as recited by claim 20.

Neither Chen nor Sekine, either alone or in combination, disclose, teach or suggest a signal input for receiving a signal representing sound originating at a plurality of positions in space, and a left channel and a right channel comprising a source placement array for filtering the sound signal in accordance with a spatial characteristic function, wherein the spatial characteristic function is a head-related impulse response, a plurality of eigen filters attached to a source placement array and receiving the signal therefrom, wherein the eigen filters introduce time delays into the signal, as recited by claim 20.

Accordingly, for at least all the above reasons, claim 20 is patentable over the prior art of record. It is therefore respectfully requested that the rejections be withdrawn.

Conclusion

All objections and rejections having been addressed, it is respectfully submitted that the subject application is in condition for allowance and a Notice to that effect is earnestly solicited.

Respectfully submitted,



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